

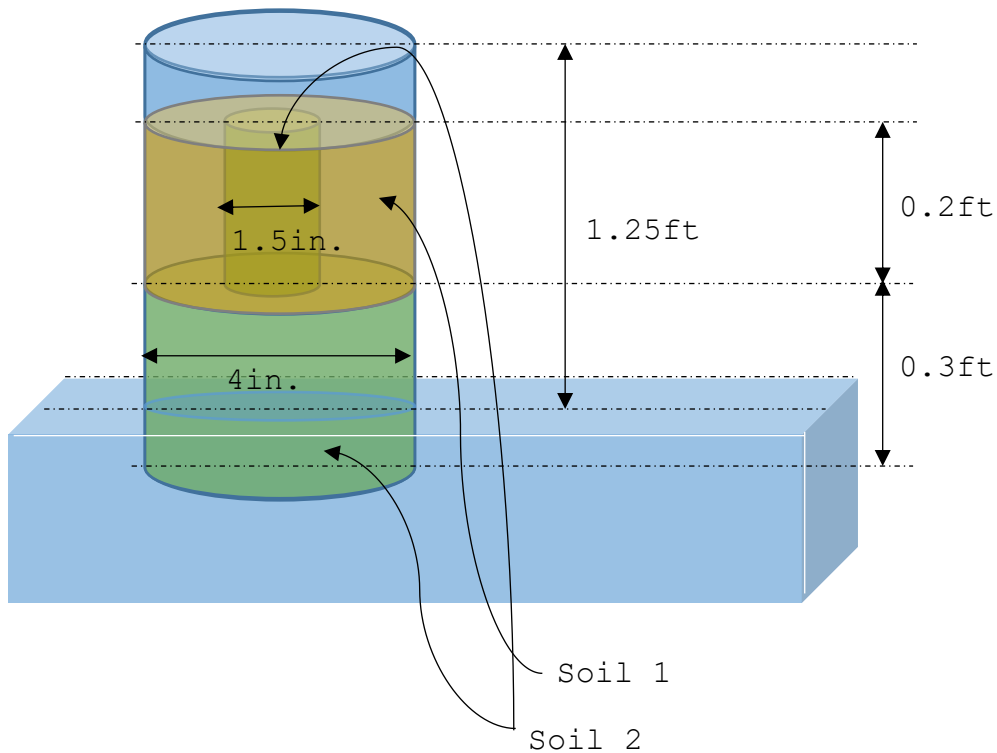
CE 602– HGE [Engr. Calaque, Dario Jr. A]

2ND QUIZ

INSTRUCTIONS:

- CHEATING IS PROHIBITED! Mind your own paper. Any act of cheating (using of cellular phones, books, and lecture materials during examination, copying answers from your seatmate, etc.) will result to failure of examination.
- No borrowing of calculator.

01. In the figure shown, Soil 1 is Silt ($k = 0.0006 \text{ ft/min}$) while Soil 2 is sand ($k = 0.002 \text{ ft/min}$)



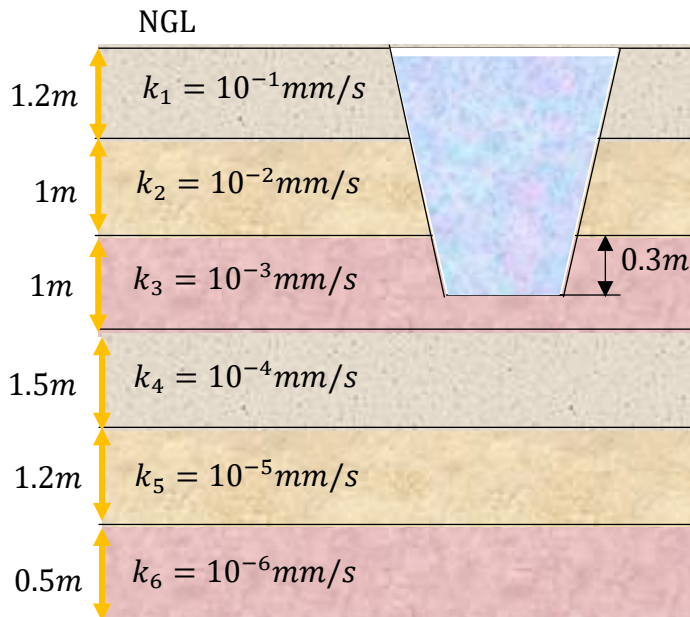
Determine the volume of water which percolates after 30min in cubic feet.

- 0.00622 cubic foot
- 0.00844 cubic foot
- 0.00733 cubic foot**
- 0.00511 cubic foot

02. The hydraulic conductivity of a clayey soil is $3 \times 10^{-7} \text{ cm/sec}$. The viscosity of water at 25degree Celsius is $0.0911 \times 10^{-4} \text{ g.sec/cm}^2$. Calculate the absolute permeability of the soil.

- $0.1733 \times 10^{-11} \text{ cm}^2$
- $0.2733 \times 10^{-11} \text{ cm}^2$**
- $0.3733 \times 10^{-11} \text{ cm}^2$
- $0.4733 \times 10^{-11} \text{ cm}^2$

03. For a given soil profile of a canal as shown in the figure. Determine the equivalent coefficient of permeability in horizontal direction on sides of canal.



- a) 0.02mm/s
- b) 0.03mm/s
- c) 0.04mm/s
- d) 0.05mm/s

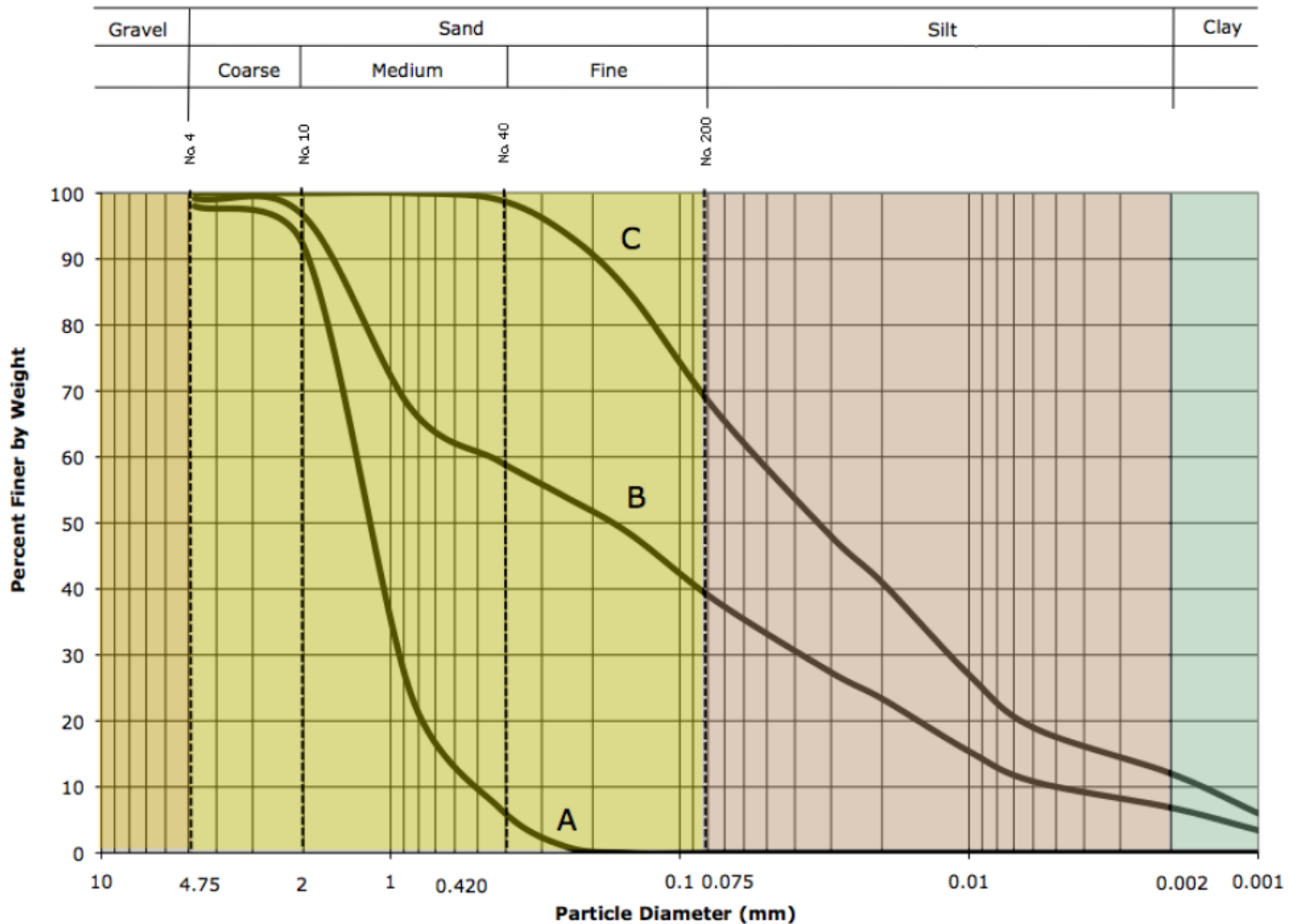
04. A 300mm diameter well penetrates 24m below the static water table. After 24hours of pumping 69liters/sec, the water level in a test well at 97.5m away from the centerline of the well is lowered 0.54m and in a test well at 33.5m away from the centerline of the well the drawdown is 1.10m. Compute the coefficient of permeability of the aquifer.

- a) $1005.1m^2/day$
- b) **$1810.1m^2/day$**
- c) $1065.3m^2/day$
- d) $121.3m^2/day$

05. A well is constructed to pump water from a confined aquifer. Two observation wells are constructed at distances of 100m and 1000m, respectively. Water is pump from the pumping well at a rate of $0.2m^3$ per minute. At steady state, the draw down is observed as 2m and 8m, respectively in the farthest and the nearest observation wells. Diameter of the test well is 1m. Determine the hydraulic conductivity K in cm/sec.

- a) $0.13 \times 10^{-3} cm/s$
- b) $1.72 \times 10^{-3} cm/s$
- c) $0.78 \times 10^{-3} cm/s$
- d) **$1.02 \times 10^{-3} cm/s$**

06. Determine the coefficient of gradation of soil A



a) 1.29

b) 2.8

c) 0.50

d) 3.5

07. For a falling head permeability test, the following values are given:

Length of Specimen = 38cm

Area of Specimen = 19cm²

$k = 0.175\text{cm/min}$

What should be the area of the standpipe for the head to drop from 64cm to 30cm in 8min?

a) 0.444cm²

b) 0.156cm²

c) 0.653cm²

d) 0.924cm²

08. For a constant head laboratory permeability test on a fine sand, the following values are given:

Length of Specimen = 250mm

Diameter of Specimen = 64mm

Head Difference = 460mm

Water collected in 2 min = 0.51 cm^3

The void ratio of the soil specimen is 0.46

Determine the seepage velocity in cm/min

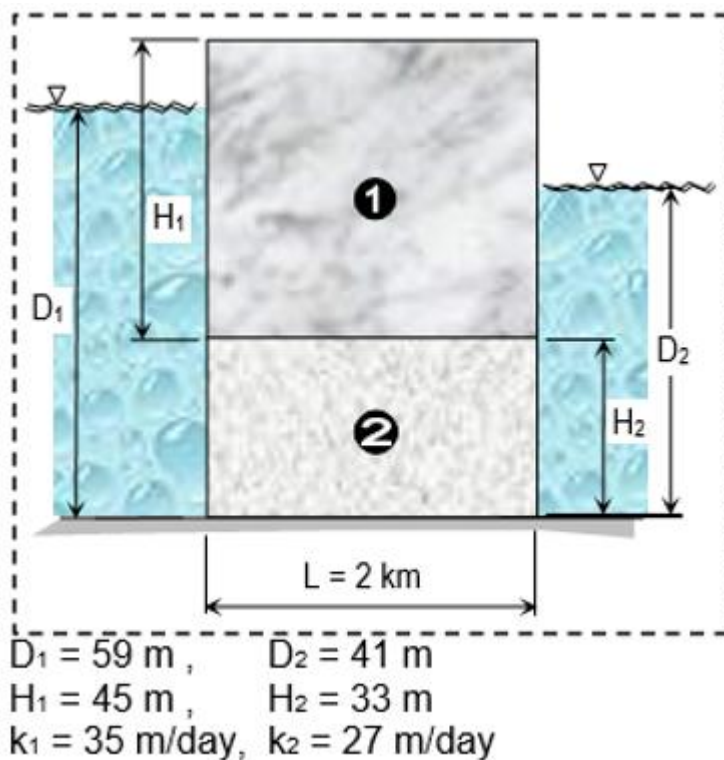
a) $2.52 \times 10^{-2} \text{ cm/min}$

b) $0.79 \times 10^{-2} \text{ cm/min}$

c) $1.33 \times 10^{-2} \text{ cm/min}$

d) $0.14 \times 10^{-2} \text{ cm/min}$

09. The figure shown below is an unconfined aquifer



Which of the following gives the equivalent horizontal coefficient of permeability?

a) 12.14m/day

b) 14.16m/day

c) 16.52m/day

d) 29.72m/day

10. The hydraulic conductivity of a sand at a void ratio of 0.71 is 0.044cm/sec. Estimate the hydraulic conductivity of this sand at a void ratio of 0.55.

Hint:

$$k \propto \left(\frac{e^3}{1+e} \right)$$

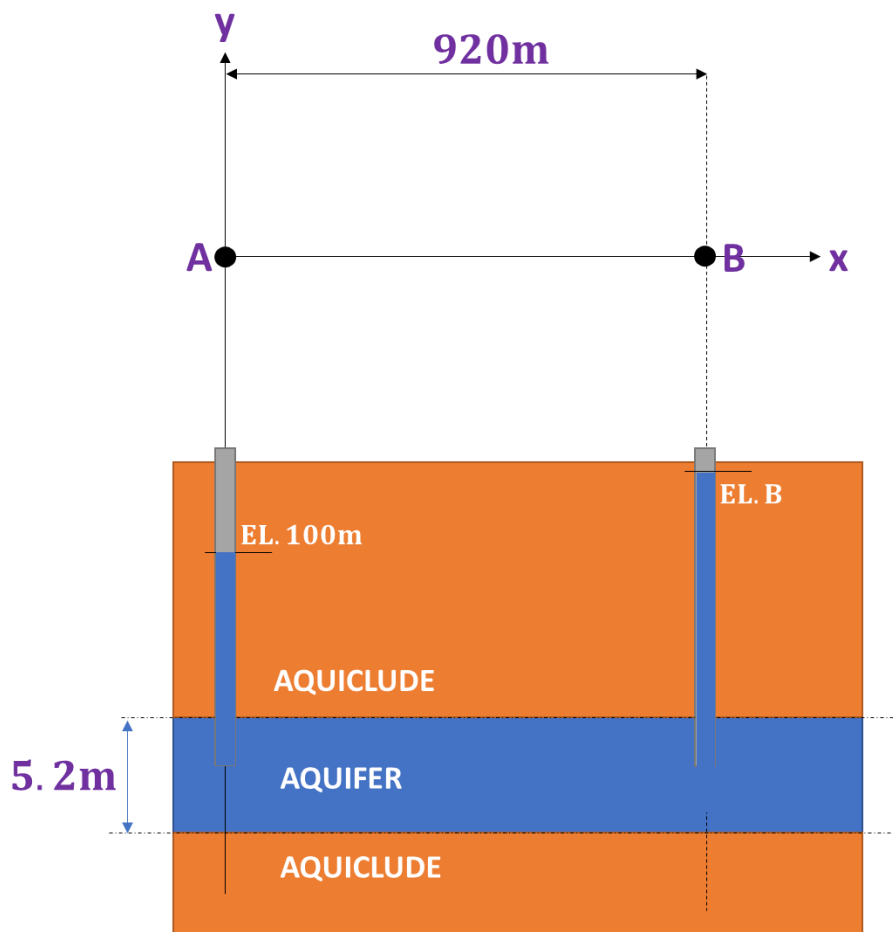
a) 0.023cm/sec

b) 0.054cm/sec

c) 0.069cm/sec

d) 0.073cm/sec

11. The flow thru the aquifer is equal to 0.560 cubic meter per day. The thickness of the aquifer is 5.2m. Two piezometers were placed along a horizontal distance of 920m apart between A and B. Elevation of water at A is 100m.



Compute the hydraulic conductivity of the aquifer, if the transmissibility of the aquifer is 80m²/day

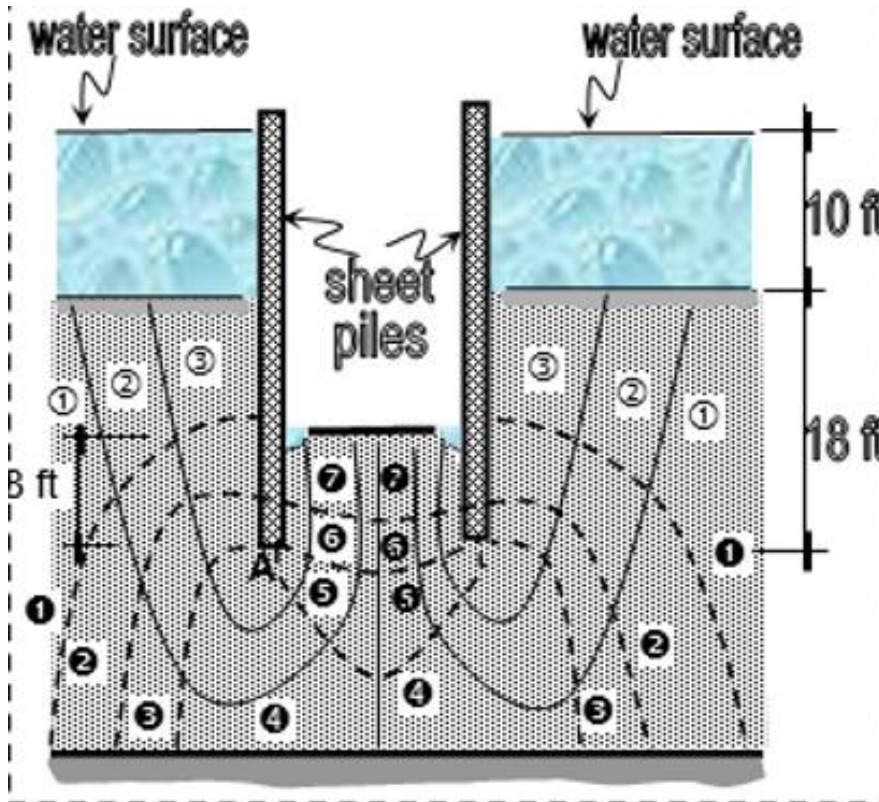
a) 3.78x10⁻⁶ cm/s

b) 2.78x10⁻⁶ cm/s

c) 1.78x10⁻⁶ cm/s

d) 0.78x10⁻⁶ cm/s

12. The depth of water outside the cofferdam as shown in the figure is 10ft and the penetration of the sheet piles below the original surface of the sand is 18ft. The water level in the ditch is 20ft below the outside water level. If $k = 5 \times 10^{-3}$ cm/sec. what will be the seepage into the ditch per foot length of the entire cofferdam?



- a) 2.56gal/min
- b) 1.26gal/min
- c) 1.88gal/min
- d) 0.63gal/min

13. The void ratio and hydraulic conductivity relation for a normally consolidated clay are given below.

Void Ratio	$k(\text{cm/sec})$
1.2	0.6×10^{-7}
1.52	1.519×10^{-7}

Estimate the value of k for the same clay with a void ratio of 1.4

Hint:

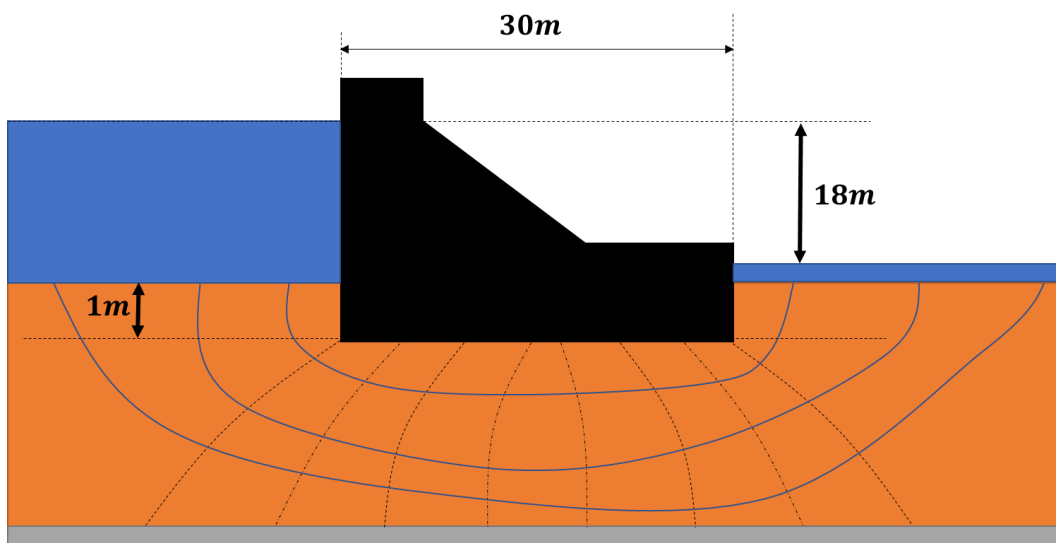
$$k \propto \left(\frac{e^n}{1+e} \right)$$

- a) $0.4 \times 10^{-7} \text{cm/sec}$
- b) $1.1 \times 10^{-7} \text{cm/sec}$
- c) $0.9 \times 10^{-7} \text{cm/sec}$
- d) $1.3 \times 10^{-7} \text{cm/sec}$

14. A 3.5m thick silty sand intersects one side of the reservoir. The strata have a hydraulic conductivity of 5×10^{-2} cm/s and extends along the entire 800m length of the reservoir. An observation well has been installed in this stratum. Compute the seepage loss from the reservoir through this stratum in liters per day.

- a) 1,412,832 liters/day
- b) 1,312,832 liters/day
- c) 1,212,832 liters/day
- d) 1,112,832 liters/day

15. For the masonry dam shown in the Figure.



$k = 5 \text{ m/day}$.

Determine the seepage flow per meter width of dam in liters per minute.

- a) 36.38 Li/min
- b) 44.58 Li/min
- c) 19.68 Li/min
- d) 27.78 Li/min

16. A permeability pumping test was carried out in a confined aquifer with piezometer level before pumping is 2.18m below the ground surface. The aquiclude (impermeable layer) has a thickness of 5.7m measured from the ground surface and the confined aquifer is 7.6m deep until it reaches the aquiclude (impermeable layer) at the bottom. At a steady pumping rate of 15.6 cubic meters per hour the drawdown in the observation wells were respectively equal to 1.62m and 0.47m. The distances of the observation wells from the center of the test well were 15m and 32m, respectively. Compute the coefficient of permeability.

- a) $2.67 \times 10^{-5} \text{ m/s}$
- b) $3.77 \times 10^{-5} \text{ m/s}$
- c) $4.87 \times 10^{-5} \text{ m/s}$
- d) $5.97 \times 10^{-5} \text{ m/s}$

17. Determine the group index of the soil according to AASHTO:

Percentage Passing No. 4 = 95%

Percentage Passing No. 200 = 70%

Liquid Limit = 30%

Plastic Limit = 24%

Table 5.1 Classification of Highway Subgrade Materials

General classification	Granular materials (35% or less of total sample passing No. 200)						
Group classification	A-1		A-3	A-2			
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7
Sieve analysis (percentage passing)							
No. 10	50 max.						
No. 40	30 max.	50 max.	51 min.				
No. 200	15 max.	25 max.	10 max.	35 max.	35 max.	35 max.	35 max.
Characteristics of fraction passing No. 40							
Liquid limit				40 max.	41 min.	40 max.	41 min.
Plasticity index		6 max.	NP	10 max.	10 max.	11 min.	11 min.
Usual types of significant constituent materials	Stone, fragments, gravel and sand		Fine sand	Silty or clayey gravel, and sand			
General subgrade rating	Excellent to good						

General classification	Silt-clay materials (more than 35% of total sample passing No. 200)			
Group classification	A-4	A-5	A-6	A-7 A-7-5 ^a A-7-6 ^b
Sieve analysis (percentage passing)				
No. 10				
No. 40				
No. 200	36 min.	36 min.	36 min.	36 min.
Characteristics of fraction passing No. 40				
Liquid limit	40 max.	41 min.	40 max.	41 min.
Plasticity index	10 max.	10 max.	11 min.	11 min.
Usual types of significant constituent materials	Silty soils		Clayey soils	
General subgrade rating	Fair to poor			

^aFor A-7-5, $PI \leq LL - 30$

^bFor A-7-6, $PI > LL - 30$

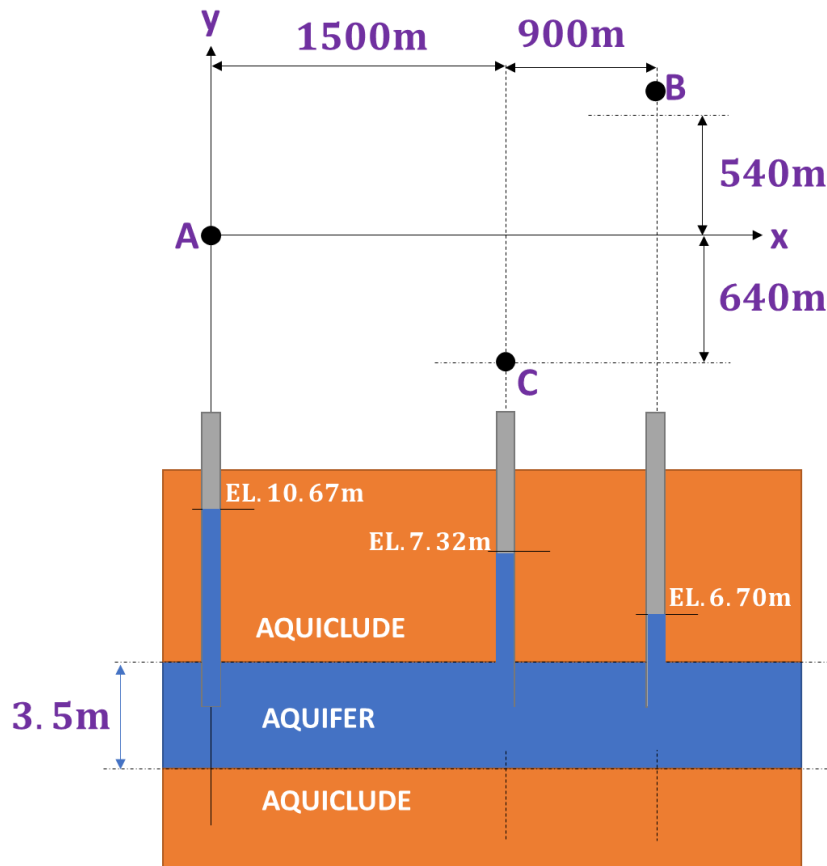
a) 2

b) 3

c) 0

d) 5

18. Three piezometers have been installed in the confined aquifer shown in the figure.



The aquifer has a uniform thickness of 3.5m and a hydraulic conductivity of 12×10^{-3} cm/s. Assume steady state hydrostatic conditions are present. Determine the transmissibility in m^2/day .

- a) 36.29
- b) 46.39
- c) 56.49
- d) 66.59

19. The result are taken from the Sieve Analysis

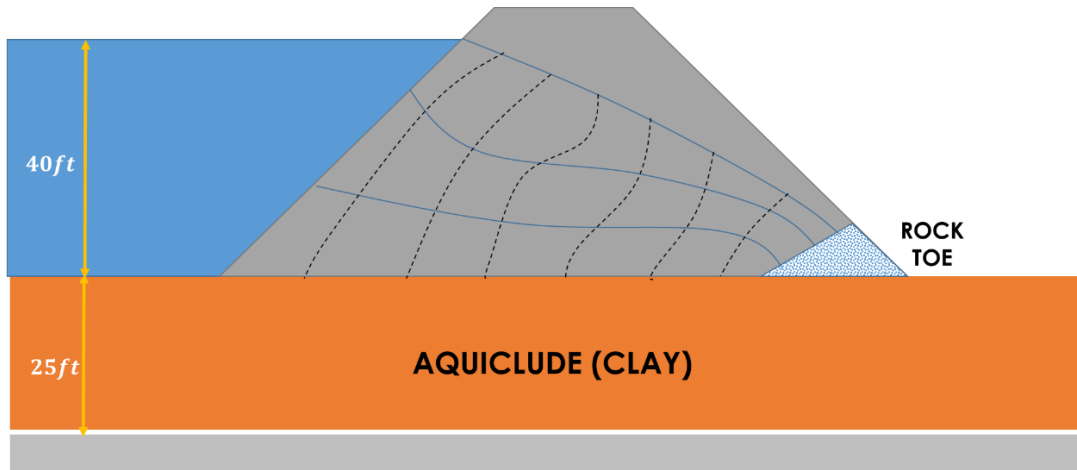
US Sieve #	%passing
4	100
10	93.20
40	81
200	55
LL	45
PL	17

Find the group index according to AASHTO Specifications.

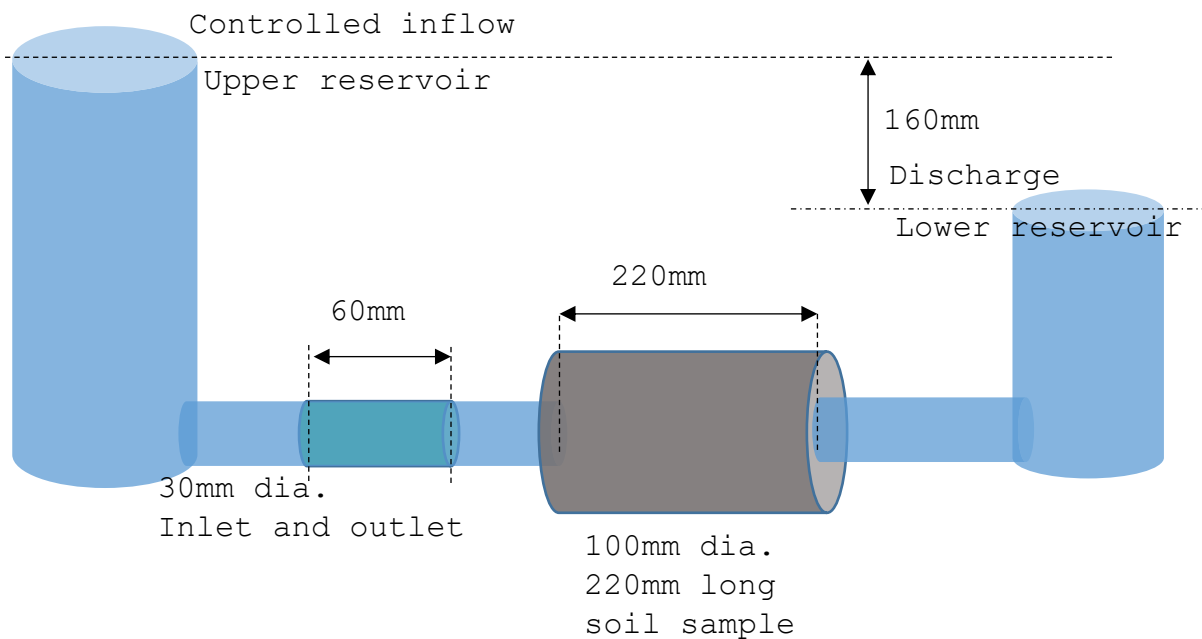
- a) 8.05
- b) 12.5
- c) 9.45
- d) 11.7

20. Find the seepage through the earth dam shown below in gallons/day if $k = 0.43 \text{ mm/sec}$ and the dam is 1200 feet wide.

- a) $18.8 \times 10^6 \text{ gal/day}$
- b) $17.8 \times 10^6 \text{ gal/day}$
- c) $16.8 \times 10^6 \text{ gal/day}$
- d) $15.8 \times 10^6 \text{ gal/day}$



21. The laboratory apparatus shown in the figure maintains a constant head in both the upper and lower reservoirs. The soil sample is a silty sand with $k = 5 \times 10^{-3} \text{ cm/s}$ and moisture content of 18.5%. Specific gravity of soil is 2.70



Determine the time required in minutes for the plug of colored water to pass through the soil. Assume there is no diffusion, for instance that the colored water plug has the same volume when it exists as when it entered the soil. In addition to that, assume the colored water has the same unit weight and viscosity as plain water for simplicity on the calculation.

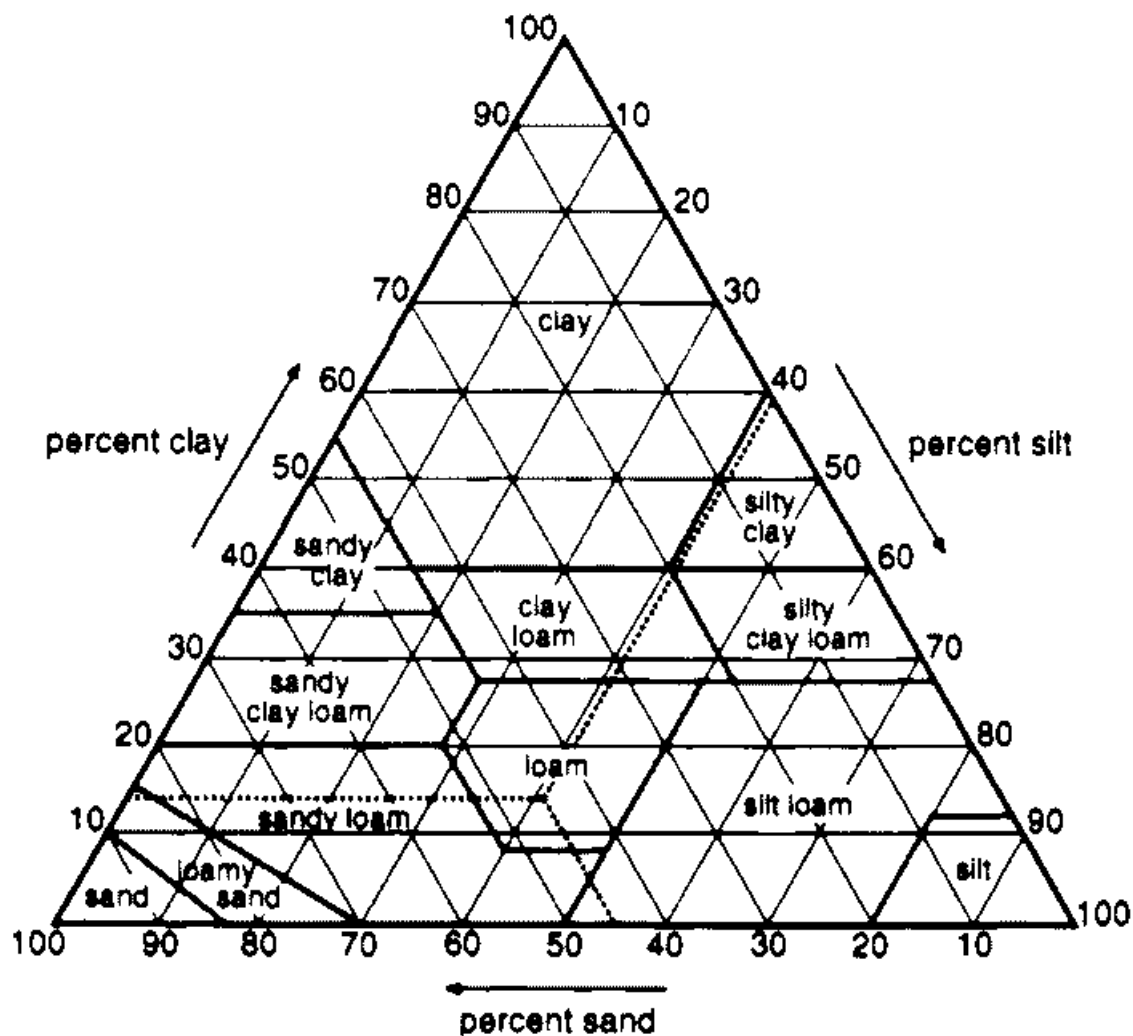
- a) 44.44mins
- b) 33.33mins
- c) 22.22mins
- d) 11.11mins

22. Classify the soil in accordance with USDA if the given soil is:

25% Sand

40% Silt

36% Clay



- a) Clay Loam
- b) Clay
- c) Loam
- d) Silt Loam

23. Classify the soil according to AASHTO:

Percentage Passing No. 4 = 60%

Percentage Passing No. 200 = 37%

Liquid Limit = 45 %

Plastic Limit = 16%

Table 5.1 Classification of Highway Subgrade Materials

General classification	Granular materials (35% or less of total sample passing No. 200)						
Group classification	A-1		A-3	A-2			
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7
Sieve analysis (percentage passing)							
No. 10	50 max.						
No. 40	30 max.	50 max.	51 min.				
No. 200	15 max.	25 max.	10 max.	35 max.	35 max.	35 max.	35 max.
Characteristics of fraction passing No. 40							
Liquid limit				40 max.	41 min.	40 max.	41 min.
Plasticity index		6 max.	NP	10 max.	10 max.	11 min.	11 min.
Usual types of significant constituent materials	Stone, fragments, gravel and sand		Fine sand	Silty or clayey gravel, and sand			
General subgrade rating	Excellent to good						
General classification	Silt-clay materials (more than 35% of total sample passing No. 200)						
Group classification			A-4	A-5	A-6	A-7	
						A-7-5 ^a	A-7-6 ^b
Sieve analysis (percentage passing)							
No. 10							
No. 40							
No. 200			36 min.	36 min.	36 min.		36 min.
Characteristics of fraction passing No. 40							
Liquid limit			40 max.	41 min.	40 max.		41 min.
Plasticity index			10 max.	10 max.	11 min.		11 min.
Usual types of significant constituent materials			Silty soils		Clayey soils		
General subgrade rating	Fair to poor						

^aFor A-7-5, $PI \leq LL - 30$

^bFor A-7-6, $PI > LL - 30$

a) A-7-6 (5)

b) A-7-5 (3)

c) A-7-6 (3)

d) A-7-5(5)

24. The following data shows the results of the sieve analysis for two soil samples A and B.

Sieve no.	Opening(mm)	Percent Passing	
		A	B
#4	4.76	90	100
#8	2.38	64	98
#10	2.0	58	90
#25	0.71	30	72
#60	0.25	22	45
#100	0.149	10	25
#200	0.074	4	0

Classify soil A using USCS method

Table 5.2 Unified Soil Classification System (Based on Material Passing 76.2-mm Sieve)

Criteria for assigning group symbols				Group symbol	
Coarse-grained soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines ^a	$C_u \geq 4$ and $1 \leq C_c \leq 3^c$ $C_u < 4$ and/or $C_c < 1$ or $C_c > 3^c$	GW GP	
		Gravels with Fines More than 12% fines ^{a,d}	$PI < 4$ or plots below “A” line (Figure 5.3) $PI > 7$ and plots on or above “A” line (Figure 5.3)	GM GC	
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines ^b	$C_u \geq 6$ and $1 \leq C_c \leq 3^c$ $C_u < 6$ and/or $C_c < 1$ or $C_c > 3^c$	SW SP	
		Sands with Fines More than 12% fines ^{b,d}	$PI < 4$ or plots below “A” line (Figure 5.3) $PI > 7$ and plots on or above “A” line (Figure 5.3)	SM SC	
	Fine-grained soils 50% or more passes No. 200 sieve	Silts and clays Liquid limit less than 50	Inorganic	$PI > 7$ and plots on or above “A” line (Figure 5.3) ^e $PI < 4$ or plots below “A” line (Figure 5.3) ^e	CL ML
			Organic	$\frac{\text{Liquid limit—oven dried}}{\text{Liquid limit—not dried}} < 0.75$; see Figure 5.3; OL zone	OL
Silts and clays Liquid limit 50 or more		Inorganic	PI plots on or above “A” line (Figure 5.3) PI plots below “A” line (Figure 5.3)	CH MH	
		Organic	$\frac{\text{Liquid limit—oven dried}}{\text{Liquid limit—not dried}} < 0.75$; see Figure 5.3; OH zone	OH	
Highly organic soils	Primarily organic matter, dark in color, and organic odor			Pt	

^aGravels with 5 to 12% fine require dual symbols: GW-GM, GW-GC, GP-GM, GP-GC.

^bSands with 5 to 12% fines require dual symbols: SW-SM, SW-SC, SP-SM, SP-SC.

$$C_u = \frac{D_{60}}{D_{10}}, \quad C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}}$$

^dIf $4 \leq PI \leq 7$ and plots in the hatched area in Figure 5.3, use dual symbol GC-GM or SC-SM.

^eIf $4 \leq PI \leq 7$ and plots in the hatched area in Figure 5.3, use dual symbol CL-ML.

GW	<15% sand	Well-graded gravel
	≥15% sand	Well-graded gravel with sand
GP	<15% sand	Poorly graded gravel
	≥15% sand	Poorly graded gravel with sand
GW-GM	<15% sand	Well-graded gravel with silt
	≥15% sand	Well-graded gravel with silt and sand
GW-GC	<15% sand	Well-graded gravel with clay (or silty clay)
	≥15% sand	Well-graded gravel with clay and sand (or silty clay and sand)
GP-GM	<15% sand	Poorly graded gravel with silt
	≥15% sand	Poorly graded gravel with silt and sand
GP-GC	<15% sand	Poorly graded gravel with clay (or silty clay)
	≥15% sand	Poorly graded gravel with clay and sand (or silty clay and sand)
GM	<15% sand	Silty gravel
	≥15% sand	Silty gravel with sand
GC	<15% sand	Clayey gravel
	≥15% sand	Clayey gravel with sand
GC-GM	<15% sand	Silty clayey gravel
	≥15% sand	Silty clayey gravel with sand
SW	<15% gravel	Well-graded sand
	≥15% gravel	Well-graded sand with gravel
SP	<15% gravel	Poorly graded sand
	≥15% gravel	Poorly graded sand with gravel
SW-SM	<15% gravel	Well-graded sand with silt
	≥15% gravel	Well-graded sand with silt and gravel
SW-SC	<15% gravel	Well-graded sand with clay (or silty clay)
	≥15% gravel	Well-graded sand with clay and gravel (or silty clay and gravel)
SP-SM	<15% gravel	Poorly graded sand with silt
	≥15% gravel	Poorly graded sand with silt and gravel
SP-SC	<15% gravel	Poorly graded sand with clay (or silty clay)
	≥15% gravel	Poorly graded sand with clay and gravel (or silty clay and gravel)
SM	<15% gravel	Silty sand
	≥15% gravel	Silty sand with gravel
SC	<15% gravel	Clayey sand
	≥15% gravel	Clayey sand with gravel
SC-SM	<15% gravel	Silty clayey sand
	≥15% gravel	Silty clayey sand with gravel

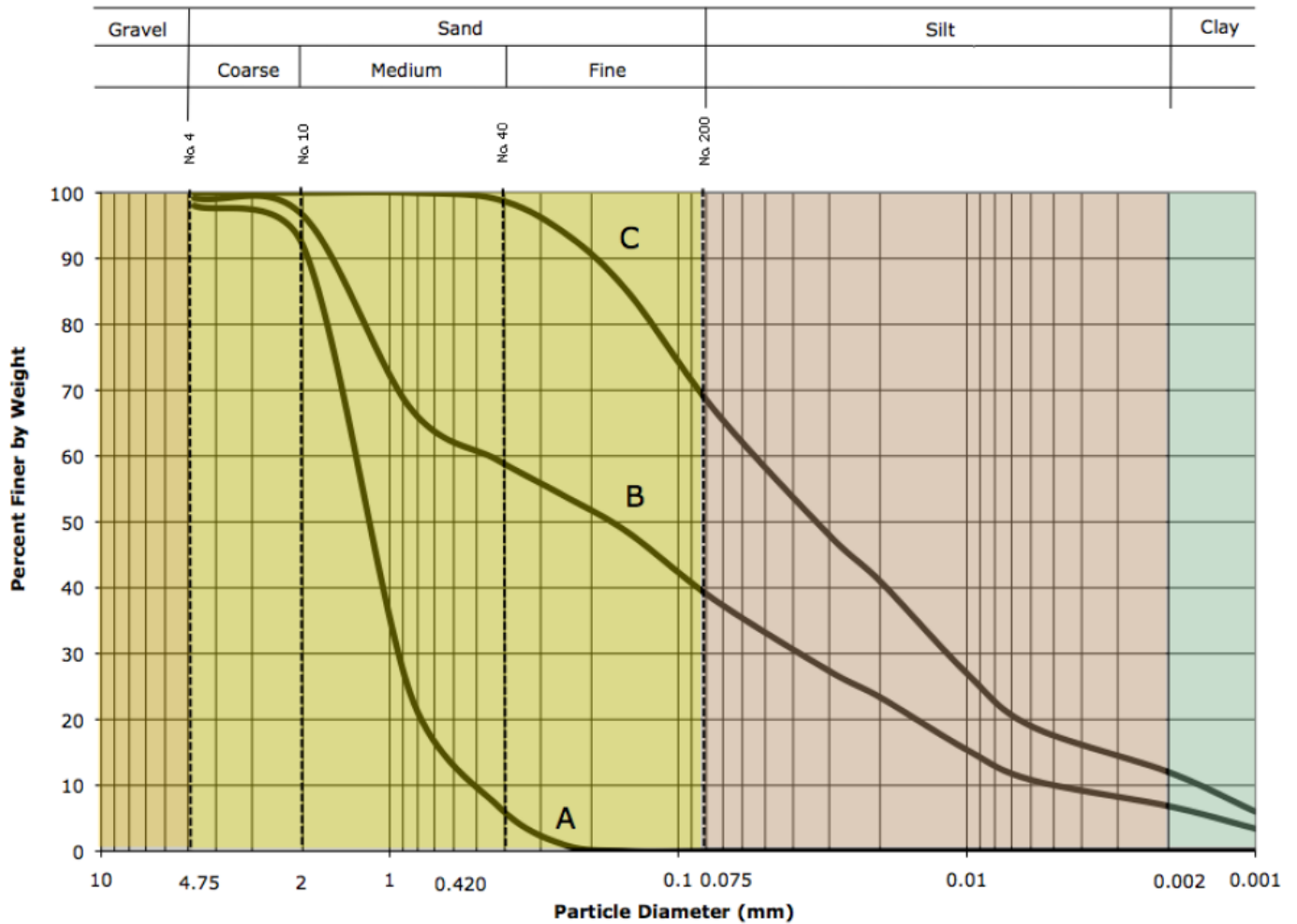
a) Well-graded sand

b) Well-graded gravel

c) Poorly graded sand

d) Poorly graded gravel

25. Classify soil A



- a) Well-graded sand
- b) Poorly graded sand
- c) Well-graded silty sand
- d) Poorly graded silty sand

-----Nothing Follows-----